

SUGAR CANE RESEARCH STATION, MAURITIUS

STAFF

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ATTACHED

Cane Breeding Officer of Department of Agriculture... A. de Sornay.



ROGUE CASE RESEARCH STATION MAINTENANCE

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FIRST ANNUAL REPORT OF THE SUGARCANE RESEARCH STATION OF DEPARTMENT OF AGRICULTURE, MAURITIUS, FOR THE YEAR 1930

INTRODUCTION

The Sugarcane Research Station of the Department of Agriculture was formed with the object of attacking the more pressing problems connected with the genetics, physiology and bio-chemistry of the sugar cane in Mauritius, the most urgent problem in hand being the search for a new cane variety to replace the Big Tanna which is now failing after a period of 30 years' supremacy in the island—the average yield of cane per acre for the whole island in 1929 was only 18.05 tons.

The laboratories of the station are situated in the building of the Mauritius Agricultural College at Réduit, while the field work is carried out on the Experimental Stations of the Department of Agriculture at Réduit and Pamplemousses and on various estates throughout the island.

The establishment provides for (a) a Senior Geneticist (in charge of the Station); (b) a Bio-Chemist and (c) a Physiological Botanist*, together with three Scientific Assistants. In addition to the above, Mr. A. de Sornay, the Cane Breeding Officer of the Department of Agriculture has been attached to the Station for work under the Senior Geneticist. Half the annual recurrent expenditure of the Station, within a maximum of £2,000 per annum for a period of five years, is being met by a grant from the Empire Marketing Board.

The Station was opened on the 15th January 1930, the day after the writer landed in the Colony.

After having organised the preliminary work in connection with the opening of the Station, I left for Java on the 25th February, returning to Mauritius on May 22nd. This visit coincided with the cane arrowing season in Java where owing to the courtesy of the scientific workers in that country I was able to gain an insight into the very successful cane-breeding methods of the Dutch†. During my absence Mr. Craig, the Bio-Chemist, took charge of the Station and by the time I returned had fully organised the preliminaries for the 1930 crossing season. Owing to the non-arrival of this officer's chemical apparatus he remained on crossing work until August, taking charge of the very successful crossing operations at Béga, Trianon and Highlands estates near Réduit.

SECTION I

CANE BREEDING WORK

1. HISTORY

The history of cane seedling work in Mauritius dates from 1871 when Mr. Lemerle reported to the "Chambre d'Agriculture" that he had discovered cane seedlings still attached to the parent plant. In 1890 "fuzz" introduced from Barbados was distributed, but only one person was successful in obtaining seedlings. The first seedlings obtained from canes grown in Mauritius were raised in 1891 by Mr. Henri de Chalain of Clémencia S.E. In the same year Mr. Perromat raised 285 seedlings which he presented to the "Chambre d'Agriculture" and was awarded a prize of Rs. 1,000 for his achievement. In the years 1893-94, over 500,000 seedlings raised by Perromat were planted at Beau Champ S.E. The success of this venture not being notable, interest in seedlings temporarily waned, being replaced by enthusiasm for the White Tanna cane. Some of Perromat's seedlings, such as 55P, 131P and 33P are still to be found locally in certain localities. On the formation of the Station Agronomique in 1893, the Director, Mr. Bonâme, who had seen previous service in Guadeloupe, placed cane seedling work on a systematic basis planting out in the field an average of 1,214 seedlings per annum between the years 1895 and 1908. Owing to the satisfactory behaviour of the White Tanna cane interest in Bonâme's enterprising seedling work was not enthusiastic so that none of his seedlings are to be found on a commercial scale in Mauritius to-day although one of them, i.e. 1900, is a well known cane in other parts of the world.

Since 1913 when the Department of Agriculture was formed cane-breeding has been regularly carried out in Mauritius, a total of approximately 1,000 seedlings, usually from uncontrolled pollinations, being planted out each year. A total of 221 "M" seedlings

* Not yet appointed.

† Subject of separate Report.

were handed over to me when I took charge of the breeding work in 1930. Many of these have since been discarded. An analysis showing the parentage and the number of seedlings produced each year and given "M" numbers for the period 1916 to 1928 is given below (Table I, page 11). It will be observed that although the Tanna varieties have been the standard ones of the island for over 30 years only six (since discarded) of the seedlings produced originated from this very successful type, owing to the fact that the Tanna canes here normally produce imperfect flowers, being male and female sterile. In addition to the 221 "M" seedlings I also took over 6,300 first year seedlings raised by the Cane Breeding Officer of the Department in 1929 before the opening of the Sugarcane Research Station. Two thousand of these were product of four crosses made in that year, the remainder being raised from selfings and general collection arrows. (See Table II, page 11).

2. BREEDING PROGRAMME, 1920

Up to the time of the appointment of a Cane Breeding Officer in October 1928 and the formation of the Sugarcane Research Station in January 1930, no full-time staff was available in the Department of Agriculture for cane-breeding work so that controlled hybridising work could not be systematically carried out, and because of this, exceedingly little information was available regarding the flowering characteristics of the various cane varieties established throughout the island. For this reason, it was necessary in this our first season to make a general survey of the behaviour and flowering habits of all those varieties available for use as parents. Our work therefore this season was concentrated on a study of the flowering characteristics of our canes and on the making of as many reasonable crosses as possible in order to obtain information regarding the best parent types and modes of inheritance.

It will be seen from reference to Table I that 74% of the "M" seedlings produced between 1916 and 1928 were derived from the three varieties 55 P, D. 109 and D. K. 74*. All these varieties we have found this year to be male-fertile so that it is very probable that a large proportion of the seedlings derived from uncontrolled pollinations during the above mentioned period have been selfs.

It was decided to proceed along two distinct lines in our breeding programme, i.e. the production of (a) intervarietal crosses between noble cane varieties and (b) interspecific crosses between noble canes and the wild cane *Saccharum spontaneum* and also between noble canes and Uba types. We attempted to make use of almost all the available varieties and as a result have discovered some very promising male and female parents for future use.

The crossing work was carried out in two neighbourhoods around Réduit and district† at 1,000 to 1,500 feet above sea level, and at Pamplémousses at 200 feet above sea level. A very real difference in climate exists between these two centres. It is hoped that by carrying out the selection work in these two districts to obtain specialised canes suited for the two main climatic zones of the island, namely, the hot lowland zone (12 months virgin crop) and the cooler and wetter highlands (18 months virgin crop). One could again subdivide these two zones into subzones according to the rainfall received and select for each area concerned, but there is a doubt in the writer's mind as to the necessity for this procedure, for over-specialisation in a cane is undesirable and there is no reason to suppose that the production of highly adaptable or universal canes, such as the old Lahaina‡ and the Big Tanna, is out of the question.

It was intended that 10,000 seedlings should be planted out at each centre, but owing to the poor fertility of the arrows at Pamplémousses it was necessary to make extra crosses in the uplands and to supply 5,000 seedlings to the lowland station to make up the required 10,000. (See Table III, page 12). This failure to obtain seedlings at Pamplémousses occasioned considerable concern at the beginning of the season and was at first thought to be due to faulty nursery methods; however some dozens of half-arrows from Réduit sown at Pamplémousses proved that this was not the case as the same percentage germination was obtained as with the other halves sown at Réduit. Incidentally these half-arrow trials demonstrated in a very definite manner the advantages to be gained, as regards the time element, by sowing fuzz in the hot climate of Pamplémousses.

As mentioned above the most successful cane type in the island, the Tanna, is usually infertile and consequently it was not successfully employed as a parent in the past. The same state of infertility was until quite recently found amongst canes of this variety in Hawaii, but within the last few years, either through a change in habit of the cane or else through improved breeding technique the Hawaiian workers are now able to obtain Tanna seedlings. With this in mind an effort was made this year to obtain Tanna seedlings here, 526 arrows being sown in large garden beds for this purpose. Four seedlings were obtained and from one of these it is hoped that a fertile Tanna type, useful for crossing purposes, will be obtained. In addition to the seedlings obtained from crosses made locally, the fuzz from six crosses (half arrows only) made in Java, and transported to Mauritius in dessicators, was sown at Pamplémousses. This fuzz was sown 12 weeks after it had left Java, 1,651 seedlings being obtained. The other half-arrows were planted in Java, where only 323 seedlings were obtained.

* D. 74 of British Guiana.

† Syn.—Bambou, Louziers, etc.

‡ Including Béga, Trianon and Highlands S. Estates.

In addition to the seedlings raised on our experimental plots, some thousands of seedlings from controlled crosses were supplied to an estate which in the past has undertaken the raising of its own seedlings from uncontrolled pollinations. In addition forty seedlings from 4,000 raised on this estate in 1929 were selected for further trial. It is hoped to extend this side of our work considerably.

3. BREEDING MATERIAL

The breeding material available for crossing this season was representative consisting as it did of a good world collection of noble canes together with a few P.O.J. varieties, Uba, Uba Seedling and Glagah, (See Table IV pp. 12 to 17). Only four arrows of Glagah were produced and from all of these crosses were obtained. Indian canes were poorly represented, Co. 213 being the only one available.

On my return from Java, I brought back with me the following canes which are now undergoing greenhouse quarantine at Réduit:—P.O.J. 2940; P.O.J. 2883; P.O.J. 2364; E.K. 28; D.I. 52; S.W. 499; Kassoer and Glagah (Kloet). The variety P.O.J. 2747 was introduced later in the year. It is unfortunate that none of these varieties will be available for breeding for a considerable time, i.e. for at least one year after their release from quarantine which normally occupies twelve months.

4. CROSSING TECHNIQUE

The original crossing programme was laid down by the writer before leaving for Java and provided for the testing of the following crossing methods, but many modifications of the original methods were found necessary before the end of the season. The methods used can conveniently be referred to as (1) the Cage; (2) the Lantern; (3) the Bag and (4) the Open Crossing Methods. With regard to the first of these, the cages used were made of oiled calico stretched on wooden frames and measured approximately 8'x10'x9'. Twelve cages were constructed. Rooted canes or cut arrows in SO₂ solution were transferred to these cages just after protrusion of the arrow and before the opening of the florets and the pollination carried out by the approach method. These cages were not a success, only three seedlings being obtained from eleven crosses made at C.E.S. and 601 from twelve crosses made at Pamplemousses. This failure was due to the high temperatures, over 106°F, experienced within them at midday which resulted in the immediate withering of the inflorescences before a cross could be attempted. Next season it is intended to give the method a further trial after re-designing the cages and providing them with double roofs and shaded walls. The method has possibilities and certain definite advantages as it allows of inflorescences being examined in a windless atmosphere and again it is possible to exercise a partial control over another dehiscence by varying the relative humidity within the cages.

In the second method, the Lanterns used were based on the Barbados design. Two types were made, the first measuring 2'x2'x3' and the second 1½'x1½'x3'; 12 being used in all. The smaller type was the more satisfactory. It was found that these lanterns could best be manipulated by suspending them by pulley and tackle from high bamboo tripods, the lantern being braced laterally to prevent oscillation in the wind. This arrangement allowed for the raising of the lantern as protrusion of the arrow proceeded. The average number of seedlings produced per cross by the lantern method was 152.

As regards the third method, several types of bag were tried, i.e. rigid, semi-rigid and loose, with or without a rain-proof canopy. All these bags were liable to damage the arrows within them owing to excessive lateral movement during high winds. A semi-rigid type consisting of a calico bag (60"x15" diameter) stretched over independent bamboo hoops and without a canopy was found to be the most serviceable type. In this type each hoop was wired to the bamboo upright from which the bag was suspended. The average number of seedlings obtained per cross using the bag method was 81 at Réduit and 4 at Pamplemousses.

The fourth method used—The Open Crossing Method of Java—was the most successful, an average of 280 seedlings per cross being obtained at the C.E.S. and 117 at Pamplemousses. The method was modified somewhat in that the male arrows were preserved in a 0.03% SO₂ solution instead of in water and further modification will be necessary in future owing to the strong South East Trades that prevail during the arrowing season. The method is somewhat uncertain as on occasion almost every arrow in a field may be found broken after the wind velocity has passed 25 m.p.h. Next season it is proposed to give a thorough trial to a wind-shield experimented with in 1930. This consisted of two light rectangular pieces of wood, approximately 24"x8", joined at right angles along one edge and nailed to the pole supporting the female arrow being so arranged as to give protection to the arrow on the windward side without actually touching the florets. From observations made of pollen being carried on an almost horizontal course in the lightest of winds, it is anticipated that such a wind-shield provides fairly efficient protection against wind-borne pollen in addition to protecting the arrow from mechanical damage.

In the case of all four methods mentioned above, a thin calico bag was put over the arrow as soon as flowering had finished and left in position until the fuzz was ready for planting.

With regard to the merits of the various methods used, for many reasons the Open Crossing Method is to be preferred to the others excepting when genetical studies may be involved. There is good reason to suppose that the more natural the crossing method used the greater chance there is of producing vigorous seedlings—how many famous seedlings from controlled pollinations have been produced other than by the Open Method?

With regard to the methods used for manipulating male arrows when using the above methods there seems to be no doubt that the SO_2 method is the most successful provided that an abundance of male arrows is available; where this is not the case then the method of rooting the canes is best (see Bio-Chemist's report, page 20). It was found that male arrows could be readily preserved for an average of five days in a 0.03% SO_2 solution, as compared with three days in water, but after that period the fertility of the pollen appeared to be affected by the toxic action of the solution. The solution was renewed every second day and an internode of each male arrow removed at the same time. Little success was achieved when keeping female arrows in SO_2 solution excepting in the case of two varieties (M. 2716 and Co. 213) which tolerated the treatment well and set seeds. With regard to the toxic effects of SO_2 mentioned above, this was found not to affect the germination of the "eyes" as internodes cut from canes in SO_2 solution were found to germinate. This is mentioned as it suggests a possible method of disinfecting setts against such diseases as Gummosis, Leaf Scald, etc.,

5. SEEDLING TECHNIQUE

Arrows were cut at 18 to 20 days after the opening of the last florets and then dried in loose paper bags for 4 days before sowing. Experiments showed that these times for cutting and sowing were the optimum. The drying of the fuzz in dessicators before sowing had no apparent effect on germination. The fuzz was planted in a thin layer at the rate of one arrow or less per box in drained wooden boxes $20" \times 14" \times 5"$, this operation being carried out in a large windproof calico cage. The seed was then covered with a thin layer of soil and heavily watered. Various controlled experiments were made to test the best sowing mixture to use, different proportions of roasted soil, coral-sand and weed-free cattle manure being tried, the general conclusion being that the richer and more open the mixture the better. After sowing the seed-boxes were placed on stands in the open, each being covered with a sheet of glass in order (1) to prevent the access of wind-borne fuzz from surrounding fields and (2) to act as a sun-trap. The glass was supported at about 1" above the box during daylight. Shade was provided at first but later was discontinued as it was found to retard plant growth and to encourage fungi. The germination of the fuzz varied enormously according to the district and the weather conditions. At Pamplemousses germination occurred on the average 7 days after planting (with extremes of 2 and 30 days) while at Réduit the interval was considerably longer, the average being 9 days with extremes of 3 and 33 days. Considerable trouble was caused at times through the growth of *Fusarium* and *Pythium* spp. in the boxes during dull weather. These fungi caused most damage when the growth of seedlings was particularly thick in which case it was found advantageous to remove, with a knife, parallel stripes of soil and seedlings, to a depth of 2 inches filling in the furrows with rich pen manure. Various sprays tried were found to be less effective in checking the fungi than bright sunshine. Very careful control of the water given prevents excessive fungoid attack. A red ascomycete was also troublesome in the early part of the season as it smothered the soil surface. This fungus only appeared on baked soil.

The growth in height of seedlings after germination was very rapid at Pamplemousses and slow at Réduit although it was noticed that the root system of the seedlings grown at the latter place was very highly developed and the tillers more numerous.

While in the box stage seedlings were given an application of a 0.2% solution of Nitrate of Potash or Sulphate of Ammonia twice per week at the rate of $\frac{1}{2}$ litre per box. The seedlings were potted out into earthenware pots of $1\frac{1}{2}$ pint capacity when between 2" and 6" high, the potting mixture used consisting of a mixture of $\frac{2}{3}$ soil and $\frac{1}{3}$ pen manure. It was found that seedlings of approximately 6" high were the most tolerant to this operation.

The potted plants were arranged in the nursery in square groups of 100 pots, each group being surrounded by a 1 foot path and a row of young maize plants to act as a trap for egg-laying Borer Moths. The maize is most efficacious when quite young so that regular plantings were made at weekly intervals. A survey was also made in all neighbouring cane fields and all shoots attacked by borers were collected and the larvæ reared in special cages for the sake of the larvæ parasites obtained. Egg parasites were also bred and released in the seedling area. As a result of these anti-borer campaigns, few seedlings were lost through borers whereas normally many plants were lost through these pests. All seedling shoots found attacked by borers were systematically removed. This is contrary to the practice in

Java but is necessary here if borers are to be kept under control. The problem of whether to remove or leave a shoot attacked by a borer in a seedling intended for comparison with a normal seedling later is a difficult one; whatever one does compensation and unnatural growth takes place.

Approximately 20,000 seedlings were potted out and are being transplanted into the field. The planting distance is $5' \times 2\frac{1}{2}'$ at Réduit and $4' \times 2\frac{1}{2}'$ at Pamplemousses. Border rows of non-experimental seedlings are being established around all seedling plots and gaps as they appear filled by recruits (non-experimental) retained for that purpose. The seedlings at Pamplemousses have irrigation water available but not those at Réduit.

Next season it is proposed to force the seedlings intended for potting at Réduit by sowing the fuzz at Pamplemousses and transporting the seedlings to Réduit later. By this means it is hoped to save at least one month.

It is proposed to keep the following data for each seedling planted out in the field:—

- (1) Seedling number and origin; (2) Date of planting; (3) Number of tillers at 6, 8 and 12 months; (4) Number of tillers removed; (5) Stem characters—diameter, length, rigidity, colour, crack, wax; (6) Leaf characters—length, width, rigidity, abscission, colour; (7) Hair—on leaves, on sheaths; (8) Presence of arrows; (9) Nature of—buds, nodes, internodes, root bands; (10) Nature of pith; (11) Dryness of stem; (12) Diseases present; (13) Pests present; (14) Number of rotten canes; (15) Number of sound canes; (16) Weight of canes produced; (17) Average weight of each cane; (18) Suchrose o/o or Refractive Index; (19) Rate.

6. LIST OF GOOD PARENTS.

An analysis of all crosses made this year (for crosses see Table IV (1 and 2) pp. 12 to 16) shows that the best "female parents" in Réduit and district in order of merit were:—Ba. 11569; R.P. 6 and M. 2016, while the best "male parents" were Senneville, M. 2716; D. K. 74; M. 1318; D. 109 and Uba Marot.

At Pamplemousses, where Ba. 11569 did not flower, the best females were R. P. 6; M. 2217 and Bambou Rayé and the best males D. K. 74; M. 2316; D. 109 and M. 2716. Glagah has not been taken into account above.

7. PERIODICITY WORK

During the early part of the arrowing season extensive studies were carried out into the behaviour of the various varieties as regards the time-periodicity of flower opening, anther protrusion and pollen shedding and the date-periodicity of boenting, flag-stage and arrow protrusion. These studies were carried out both in the lowland and upland areas. It was found that the behaviour of any one variety as regards time-periodicity varied enormously, depending on situation, weather conditions and the lateness of season. As a consequence it is believed that in crossing work each arrow should be treated on its merits and next season it is proposed not to continue with time-periodicity studies as it is felt that the staff can more profitably spend their time in other directions. Date-periodicity will again be studied as it would appear that the behaviour in this direction is fairly constant for each variety.

As showing the variation as between the various varieties, it was found at Pamplemousses that Uba Marot which opens its flowers at 1 a.m. sheds its pollen at 5 a.m. while such varieties as 131P, 55P and D.K. 74 often open their flowers at midnight and do not shed pollen until 7.30 a.m. Normally flowers open at 4.30 to 5.30 a.m. and pollen shedding beginning at 7 to 7.30 a.m. At times 131P was found to open during the day shedding its pollen immediately. Certain varieties namely P. O. J. 213, M. 2716 and to a lesser extent 55P and 131P were observed, on being dissected before protrusion of the arrow, to have occasional open flowers inside the sheath.

It is of interest to note that of all the varieties examined during this work only three were observed to be visited by bees.

8. POLLEN EXAMINATION

Some thousands of pollen tests were carried out throughout the flowering season; one officer being wholly occupied on this work. The following data was collected for each variety examined:—Colour of anthers; Percentage of anthers open, half-open and shut; Reaction to Iodine Test; Percentage germination of pollen. The germinating medium used consisted of a solution of 26% suchrose and 0.7o/o agar-agar. This was found quite suitable for germinating the pollen of "notle" cane varieties, but it appears to be unsuited to *Saccharum spontaneum* and its crosses. In an endeavour to discover a more suitable medium some millions of stigmas were collected for extraction and chemical analysis and it is proposed to base experiments with other media on the results obtained. With the medium used this season the most virile male varieties gave a germination of approximately 30o/o at the height of the flowering season, but towards the end of this period it was noticed that

an increasing number of pollen grains burst in the medium either before or after protrusion of the pollen tube. The proportion of pollen-grains-with-tubes to burst-pollen-grains varied widely but the sum of the two remained fairly constant for any one variety. Variations in the concentration of the medium between 20 and 30% suchrose and in the relative humidity of the moist chamber used did not prevent the trouble. Bursting only takes place in living pollen. It would appear that as the season advances there is a definite falling off in the elasticity of the inner membranes of the pollen grain and that a rupture takes place as soon as germination begins. This phenomenon is not properly understood and attention will be directed to it in future.

The following conclusions have been drawn from this season's pollen work :—

- (1) That the percentage germination figure of any variety has no absolute value owing to variability due to time and place.
- (2) That all flowers with red anthers give large amounts of viable pollen (with one exception).
- (3) That all flowers with yellow anthers give no pollen.
- (4) That certain varieties (131P ; 55P. and R. P. 6) produced red and yellow anthers, occasionally on the same arrow.
- (5) Using the figure percentage-of-open-anthers as a measure of the quantity of pollen produced no significant correlation could be found between quantity and quality as determined by the Suchrose test.
- (6) A significant correlation was found between the quality of the pollen as measured by the Iodine Test and the quality as determined by the Suchrose Test.
- (7) That direct sunlight has a lethal effect on pollen.
- (8) That cut arrows kept in SO_2 solution are not inhibited as regards pollen shedding or germination until after 5 to 7 days immersion after which time only yellow anthers are usually produced and the inflorescence loses its male characteristics.

SECTION II.

OTHER INVESTIGATIONS.

1. X-RAY EXPERIMENTS WITH INFLORESCENCES AND SEEDLINGS

Following the success of Goodspeed and Olsen, Stadler and other workers in producing mutations in tobacco, barley, etc., by means of X-Radiations an attempt was made this year to apply this method to the sugarcane in the hope that useful mutant forms might be obtained. Further, it was hoped that male sterility in canes that were normally male-fertile might be produced by radiation thus enabling us to castrate such canes and to use them as female parents. These experiments were made possible by the co-operation of the Medical and Health Department. Several difficulties stood in the way of the castration experiment the chief of these being (1) the difficulty of transporting flowering canes, 10 feet long, from the Experiment Station to the X-Ray Department, 4 miles away, and (2) the difficulty of finding a variety which would tolerate SO_2 treatment over a long period without gradually losing its male fertility. The first of these difficulties was overcome by using specially prepared cut arrows in large containers of SO_2 solution and the second by the discovery that the variety M. 2716 would tolerate SO_2 treatment and would continue to produce pollen almost normally even after 10 days in the solution. Owing to these delays this experiment was not begun until the arrowing season was almost over and consequently flowers were behaving erratically, so much so, that owing to the very erratic behaviour of the controls no conclusion could be drawn from the results of the second of the castration experiments. Nothing was known of the tolerance of the sugarcane sex organs to X-Rays and the doses given were purely tentative and varied from 2 minutes at 68 K.V.P.; 4 m.a. tube current at 19 cms target distance (unfiltered radiation) to 10 minutes at 88 K.V.P., 6 m.a. tube current at 38 cms target distance in the first experiment and from 2 to 8 minutes at 90 K.V.P., 4 m.a., 19 cms in the second experiment. Conclusions could only be drawn from the results of the first experiment and these were (1) that none of the doses given were sufficient to prevent subsequent protrusions of anthers and germination of pollen, and (2) that the lower doses given had a stimulating effect on anther protrusion.

Later in the season, 7 weeks' old cane seedlings were subjected to radiation. Here again no information was available regarding the tolerance of sugarcane seedlings to the rays and the experiment was carried out more with the idea of discovering this tolerance than with the idea of finding mutants in the small number treated. Four batches of seedlings totalling 550, all from the same half arrow of the cross M. 2016 x M. 2716, were

given doses varying from 1 to 3 minutes at 78 K.V.P., 3 m.a., tube current, 35 cms target distance (unfiltered). These are now to be planted out in the field adjacent to the non-radiated controls grown from the other half of the arrow.

2. MUTATIONS.

(a) In the early part of the season the writer was struck by the frequency with which new colour-sports occurred amongst the various cane varieties in the island. With the intention of discovering the extent of this sporting, a close search for bud mutations was made at harvest time over an area of approximately 8.6 acres. This area contained approximately 27,700 stools, the total number of varieties represented being 207. From this area no less than 31 obvious bud sports were found, i.e. colour sports not previously observed. It was argued that if colour sporting was any measure of the sporting that occurs in other directions and further if these mutants could be discovered the phenomenon might be exploited. As the agricultural value of a sugarcane variety depends on the factors (a) sucrose content, (b) number of canes per stool, and (c) weight of each cane and further as a high-weight bud sport might be detected by eye, it was thought worth while to examine every giant cane in a stool that came to notice. Three such canes were discovered on the 8.6 acres and their juices examined by the refractometer method and compared with the total-solids analysis of the remaining canes in the stool. One of these proved on examination to be a "water-shoot": the two others were cut into setts and planted in the field, beside controls from the same variety, for further examination. Although it is realised that clonal selection, as a method of producing new varieties, is unpromising as compared with the possibilities of obtaining vigorous hybrids by judicious crossing yet the method has its possibilities and is worth investigating. The most successful cane grown in the island within the last 30 years, i.e. the White Tanna, originated as a mutation of the Striped Tanna.

(b) Fifty-six Albino Seedlings were observed amongst the 53,000 seedlings raised in boxes at Réduit and Pamplemousses during the year and of these no fewer than 38 originated from crosses in which Ba. 11569 was used as the female parent.

3. SEEDLING TRIALS.

At the beginning of the season I decided that one of our most urgent problems was to discover and to standardise a satisfactory scheme of small-scale yield trials to test our seedlings against the established standard varieties. The Dutch success with sugar in Java is largely due to their scientifically designed field trials conducted by the growers themselves under the supervision of scientific workers so that all promising seedlings can be scientifically tested in a comparatively short space of time. In Mauritius the testing of seedlings presents a difficult problem for several reasons, chief of which are:—(1) The great variation in climate as between areas closely situated thus making necessary the laying down of yield trials in each climatic zone and (2) the existence in the cane fields of numerous stone walls which preclude the use of a chess-board layout for experiments.

In the past selected seedlings here have first been put into six-hole trials followed by 30, 60 and 150-hole trials in subsequent years. As a rule the rows of each variety were not replicated in any one experimental area so that Probable Error figures were high. The system has now been modified so that in the case of 150-hole trials each variety has 4 replicates (i.e. 5 rows of 30 holes) there being a "standard" row on each side of each variety being tested, thus:—

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
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In the case of 30-hole trials the same general plan is followed, three rows each of 10 holes being grown in the case of each variety. Sixty-hole trials are to be abandoned. It is proposed to substitute a Latin-Square type of trial (10×10) for the 6-hole trial system previously used for the preliminary testing of seedlings as it is calculated that by examining first-year seedlings by the refractometer method that at least 10 cuttings can be obtained for planting in the first trial.

Twelve row trials (150-hole type or larger) were laid down on the above plan in the chief zones of the island during the year to test various imported varieties together with what I considered to be the most promising "M" varieties against the standard canes of the past. Four of these trials were conducted by estates at their own expense.

As regards large scale field trials these will be laid down according to the same general plan shown above.

4. MANURIAL TRIALS

At a meeting of the Soils Advisory Committee held in January, I put before the Committee proposals for a standard form of manurial trial to test the effect of varying applications of nitrogen fertilisers to virgin canes as the view had been expressed that these fertilisers were not being applied in economic quantities, the dressing being considered excessive in many instances. A plan of this manurial trial is given below:—

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Border Plot	Standard	A	Standard	B	Standard	C	Standard	A	Standard	B	Standard	C	Standard	A	Standard	B	Standard	C	Standard	Border Plot

Size of each plot=0.25 acres (approximately).

TREATMENTS FOR THE DIFFERENT PLOTS:—

Standard Plots	...	... No Nitrogen in form of artificial fertilisers	
"A" Plots	...	... Same as Standard Plots	
		+20 lbs. N. as Sulphate of Ammonia	} per acre
		+20 lbs. N. as Nitrate of Soda	
"B" Plots	...	... Same as Standard Plots	
		+40 lbs. N. as Sulphate of Ammonia	} per acre
		+40 lbs. N. as Nitrate of Soda	
"C" Plots	...	... Same as Standard Plots	
		+60 lbs. N. as Sulphate of Ammonia	} per acre
		+60 lbs. N. as Nitrate of Soda	

Eight nitrogen experiments as above were laid down during the year, the cost being borne by the various estates concerned. The yields from these trials will be recorded by officers of this Department and the results analysed by the usual statistical methods and circulated to the estates.

Similarly designed experiments are now being laid down to determine the optimum application of phosphates to virgin canes.

5. ROOT STUDIES

As no root studies have been conducted on the very successful White Tanna cane of the island it was thought desirable to undertake this work and if possible to compare its root system with that of such a successful Java cane as P.O.J. 2878. Four stout wooden boxes 3'x3'x3' were constructed for the purpose, three wire frames being stretched across each box in order to hold the roots in position for study after the removal of the soil which it is proposed should be done by means of a water jet, one side of each box being removable for this purpose. Each box was filled with soil from a hole of the same dimensions as the box, top soil and subsoil occupying the same relative positions as they would in the natural state. Two boxes have been planted with P.O.J. 2878 and two with White Tanna, one sett only being planted in each box.

6. GROWTH RATE EXPERIMENTS

With a view to undertaking a detailed study of the relative influence of the various factors affecting cane growth a series of growth rate experiments was begun at Réduit and Pamplemousses using the varieties White Tanna and P.O.J. 2878. The weekly growth rate of each cane in ten stools (5 of each variety) at each centre is being recorded and the growth curves studied in relation to wind velocity, sunlight, rainfall, soil moisture, temperature and humidity. The canes being studied will reach maturity in September 1931. These experiments should give valuable information on the influence of varying wind velocities on cane growth.

Réduit,
Mauritius.

A. GLENDON HILL,
Senior Geneticist.

TABLE I.
MAURITIUS SEEDLINGS AND THEIR ORIGIN
(1916-1928)

Parents	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	Totals
55P ...	12	23	15	15	2	10	14	11	6	25	18	21	11	183
D.109 ...	...	7	8	13	5	4	1	3	...	...	17	45	52	155
DK. 74 & (DK. 74 striped)	4	6	31	3	3	1	1	2+(3)	4	...	3	12	80	153
33P ...	...	14	17	2	4	3	1	...	2	...	2	1	...	46
131P ...	8	7	1	2	5	...	7	...	...	...	5	9	...	44
800 ...	...	...	...	12	...	...	...	...	...	...	...	...	...	12
D.130 ...	...	5	...	...	...	...	...	...	1	...	...	...	...	6
R.P.6 ...	...	...	...	...	...	...	...	...	...	...	6	...	...	6
St. Aubin No. 2	...	...	...	...	...	2	...	...	1	...	...	...	...	3
White Tanna	...	...	2	...	...	...	...	...	...	...	...	...	...	2
Striped Tanna	...	...	...	1	...	...	...	...	...	...	...	...	...	1
18807 ...	...	...	...	...	...	...	5	...	...	...	...	...	...	5
79097 ...	...	...	...	2	3	...	...	...	...	...	...	...	...	5
106 ...	...	4	...	...	...	...	...	...	...	...	...	...	...	4
M.55 x D.109	...	...	...	...	4	...	...	...	...	...	...	...	...	4
D.625 ...	2	...	...	...	2	...	...	...	...	...	...	...	...	4
87P ...	...	...	1	...	...	...	...	...	2	...	...	...	...	3
Iscombine ...	3	...	...	...	...	...	...	...	...	...	...	...	...	3
33/55 ...	...	...	...	...	...	2	...	...	...	...	...	...	...	2
Uba Marot ...	...	...	...	...	...	...	...	...	...	...	...	2	...	2
10306 ...	...	...	...	...	...	...	2	...	...	...	...	...	...	2
Uba Seedling	...	...	...	...	...	...	...	1	1	...	...	...	...	2
M.30 ...	...	1	...	...	...	...	...	...	...	...	...	...	...	1
John Bull ...	1	...	...	...	...	...	...	...	...	...	...	...	...	1
P.O.J. ? ...	...	...	...	...	...	...	...	...	...	...	1	...	...	1
P.O.J. 161 ...	...	...	...	1	...	...	...	...	...	...	...	...	...	1
7500 ...	...	...	...	...	1	...	...	...	...	...	...	...	...	1
D.117 ...	...	...	...	...	1	...	...	...	...	...	...	...	...	1
Red Mauritius	...	...	...	...	...	1	...	...	...	...	...	...	...	1
H.109 ...	...	...	...	...	...	...	1	...	...	...	...	...	...	1
White Tanna x D.K.74	...	...	...	...	...	...	1	...	...	...	...	...	...	1
P.O.J.203 x D.109	...	...	...	...	...	...	1	...	...	...	...	...	...	1
D.95 ...	...	...	...	...	...	...	1	...	...	...	...	...	...	1
126 ...	...	...	...	...	...	...	...	...	1	...	...	...	...	1
Totals	30	67	75	51	30	23	35	20	18	25	52	90	143	659

The above is a list of those seedlings given "M" numbers. About 1,000 seedlings were planted out each year.

TABLE II
LIST OF SEEDLINGS PLANTED OUT BY CANE BREEDING OFFICER
IN 1929, SHOWING PARENTAGE

Parentage	No. of Seedlings planted out
P.O.J. 213 x Uba Marot ...	870
131 P x Uba Marot ...	1,110
55P (selfed) ...	49
55P (General Collection) ...	61
White Tanna (General Collection) ...	12
Uba x D. 109... ..	4
Mapou Perlé x D. 109 ...	7
131P (General Collection) ...	56
D.109(" ") ...	75
D.K. 74 (selfed) ...	1,596
D.K. 74 (General Collection) ...	849
D. 109 (selfed) ...	1,593
Uba Marot (selfed) ...	39
Uba Marot (General Collection) ...	20
	<u>6,341</u>

TABLE III
ORIGIN OF SEEDLINGS 1930

Location	No. of seedlings obtained from		Uncontrolled	Total
	Crosses	Selfings		
Réduit and district	33,718	963	7,474	42,155
Pamplemousses	9,275*	593	1,740	11,608
	42,993	1,556	9,214	53,763

* Including 3,171 from fuzz introduced from Java.

TABLE IV.

List of Crosses made during season 1930.

1.—CROSSES BETWEEN "NOBLE" CANES.—

Location :—C.E.S.=Central Experiment Station, Réduit ; P.E.S.=Pamplemousses Experiment Station.

Combination	Location of Cross	No. of Arrows sown	No. of Seedlings obtained	No. of seedlings potted at	
				C.E.S.	P.E.S.
Canne Antelme x M. 1221	C.E.S.	1	...	...	...
Bambou Rayée x D.K. 74	P.E.S.	2	460	142	269
Bambou Rayée x M. 87	P.E.S.	1	38	...	38
Bambou Rayée x M. 131	P.E.S.	1	5	...	5
Bambou Rayée x M. 2916	C.E.S.	1	6	2	...
B. 6308 x D.K. 74	C.E.S.	1	...	...	...
B. 6308 x M. 2716	C.E.S.	1	1	1	...
B. 6450 x D.K. 74	C.E.S.	1	1	1	...
Ba. 11569 x D.K. 74	Béga	1	2,200	228	117
Ba. 11569 x D.K. 74	C.E.S.	1	23	16	...
Ba. 11569 x D. 109	C.E.S.	1	630	328	...
Ba. 11569 x M. 55	C.E.S.	1	1	1	...
Ba. 11569 x M. 131	Béga	1	1,600	488	225
Ba. 11569 x M. 55	Béga	1	7	0	...
Ba. 11569 x M. 131	C.E.S.	2	1	1	...
Ba. 11569 x M. 2716	C.E.S.	1	251	206	...
Ba. 11569 x M. 2716	Béga	3	4,021	136	599
Ba. 11569 x M. 1318	C.E.S.	1	90	83	...
Ba. 11569 x R.P. 6	Béga	2	28	17	11
Ba. 11569 x Senneville	Béga	1	2,200	607	225
D.K. 74 x D. 109	P.E.S.	1	44	...	44
D.K. 74 x M. 2716	Béga	1	135	118	...
H. 109 x D.K. 74	P.E.S.	1	53	...	8
H. 109 x D.K. 74	C.E.S.	1	...	...	...
H. 109 x M. 2716	C.E.S.	1	...	...	...
Louzier x D.K. 74	Highlands	2	...	...	...
Mapou Perlé x M. 87	P.E.S.	1	...	...	...
M. 55 x D.K. 74	C.E.S.	3	2	2	...
M. 131 x D. 109	P.E.S.	1	...	...	...
M. 131 x D.K. 74	P.E.S.	2	19	19	...
M. 131 x D.K. 74	Béga	4	244	129	...
M. 131 x D.K. 74	C.E.S.	1	...	...	...
M. 131 x M. 55	Béga	1	14	...	...
M. 131 x M. 117	Béga	1	2	...	...
M. 131 (o+) x M. 131 (o- →)	Béga	1	...	...	...
M. 131 x M. 2716	Béga	2	12	...	...
M. 131 x M. 3517	Béga	1	...	...	...
M. 131 x R.P. 6	Béga	1	6	6	...
M. 131 x Senneville	Béga	1	4	4	...
M. 1516 x D.K. 74	P.E.S.	1	1	...	...
M. 1516 x M. 55	P.E.S.	2	...	...	...

TABLE IV.—(Contd.)

Combination	Location of Cross	No. of arrows sown	No. of seedlings obtained	No. of seedlings potted at	
				E. S.	P. E. S.
M. 1516 x M. 55	C.E.S.	2	2	...	...
M. 2016 x D.K. 74	Béga	1	660	290	87
M. 2016 x D. 109	C.E.S.	1	1,033	314	...
M. 2016 x M. 55	Béga	1	17	17	...
M. 2016 x M. 2316	C.E.S.	1	...	...	...
M. 2016 x M. 2716	Béga	1	2,900	574*	...
M. 2016 x M. 3517	Béga	1	89	31	...
M. 2016 x M. 720	C.E.S.	1	16	16	...
M. 2316 x B. 3390	C.E.S.	2	...	...	...
M. 2316 x D. 109	P.E.S.	1	...	...	...
M. 2316 x D.K. 74	Béga	2	98	63	...
M. 2316 x M. 55	Béga	1	2	1	...
M. 2316 x M. 131	Béga	1	9	8	...
M. 2316 x M. 2716	Béga	1	31	27	...
M. 2316 x M. 3517	Béga	1	31	24	...
M. 2916 x R.P. 6	P.E.S.	1	...	...	...
M. 117 x D.K. 74	Béga	1	170	72	43
M. 117 x M. 131	Béga	1	46	24	...
M. 117 x M. 3517	Béga	1	72	57	...
M. 2217 x D.K. 74	P.E.S.	1	24	...	24
M. 2217 x M. 2316	P.E.S.	1	450	223	200
M. 1718 x D.K. 74	C.E.S.	2	4	3	...
M. 3319 x D. 109	P.E.S.	2	59	...	59
M. 3319 x D.K. 74	"	1	9	...	9
M. 3319 x M. 131	"	1	...	...	...
M. 3319 x M. 2916	C.E.S.	2	95	55	...
M. 3319 x M. 1318	"	2	2	...	...
M. 3319 x M. 3619	P.E.S.	1	...	...	...
M. 3319 x Senneville	"	1	2	...	2
M. 3319 x Striped D. 109	"	1	...	...	...
M. 2620 x D. 109	"	1	7	...	7
M. 2620 x M. 2316	"	2	133	...	133
M. 2620 x Senneville	"	1	28	...	28
M. 221 x M. 1318	C.E.S.	2	3,470	346	433
M. 822 x M. 2916	P.E.S.	1	...	...	...
M. 1022 x M. 2316	"	1	176	...	166
M. 1022 x M. 3619	"	2	60	...	60
M. 1123 x M. 131	"	2	2	...	1
M. 1123 x M. 2316	"	1	47	...	47
M. 1123 x Senneville	"	1	23	...	23
M. 1324 x D.K. 74	"	2	13	...	13
M. 1324 x M. 87	"	1	140	...	135
M. 1324 x M. 131	"	1	...	...	...
M. 1324 x M. 2425	C.E.S.	1	...	...	...
M. 1524 x D.K. 74	"	1	7	3	...
M. 1524 x D. 109	"	2	2	2	...
M. 1524 x M. 131	"	1	1	...	...
R.A. 29 x D. 625	P.E.S.	1	...	...	...
R.A. 29 x D.K. 74	"	1	...	...	...
R.A. 29 x M. 55	"	2	...	...	...
R.A. 29 x M. 87	"	1	34	33	...
R.A. 29 x M. 131	"	1	...	...	...
R.A. 29 x M. 2316	"	1	...	...	...
R.A. 29 x M. 2916	"	2	...	...	...
R.A. 29 x R.A. 10	"	1	...	...	...
R.A. 29 x R.P. 6	"	2	...	...	...
R.A. 29 x Striped D. 109	"	1	...	...	...
Rose Bambou x D. 109	"	2	...	...	...
Rose Bambou x D.K. 74	"	1	...	...	...
Rose Bambou x M. 2316	"	1	...	...	...
R.P. 6 x Antelme	C.E.S.	4	...	...	...
R.P. 6 x B. 3390	P.E.S.	1	5	...	5
R.P. 6 x D. 109	"	1	474	...	424

* 300 of these seedlings were X-rayed in the seed boxed.

TABLE IV.—(Continued)

Combination	Location of Cross	No. of arrows sown	No. of Seedlings obtained	No. of seedlings potted at	
				C.E.S.	P.E.S.
R.P. 6 x D. 109 ...	C.E.S.	1	400	210	...
R.P. 6 x D.K. 74 ...	P.E.S.	4	2,580	...	1,030
R.P. 6 x D.K. 74 ...	C.E.S.	4	753	437	47
R.P. 6 x D.K. 74 ...	Béga	3	3,225	328	400
R.P. 6 x M. 55 ...	Béga	1	...	...	...
R.P. 6 x M. 55 ...	P.E.S.	2	48	...	48
R.P. 6 x M. 55 ...	C.E.S.	1	4	1	...
R.P. 6 x M. 87 ...	P.E.S.	2	32	...	31
R.P. 6 x M. 131 ...	"	2	10	...	6
R.P. 6 x M. 131 ...	Béga	2	680	262	225
R.P. 6 x M. 131 ...	C.E.S.	1	...	...	...
R.P. 6 x M. 2316 ...	P.E.S.	2	353	...	308
R.P. 6 x M. 2716 ...	"	4	471	...	15
R.P. 6 x M. 2716 ...	Béga	1	600	345	...
R.P. 6 x M. 2916 ...	P.E.S.	1	...	...	...
R.P. 6 x M. 3517 ...	Béga	1	1,300	100	300
R.P. 6 x M. 2425 ...	C.E.S.	1	...	...	...
R.P. 6 x Senneville ...	Béga	1	2,800	230	225
R.P. 6 x Senneville ...	P.E.S.	1	165	...	165
R.P. 73 x M. 2916 ...	C.E.S.	2	o	1	...
White Tanna x D. 109 ...	P.E.S.	3	...	...	...
" x D.K. 74 ...	P.E.S.	20	...	...	...
" x D.K. 74 ...	C.E.S.	2	...	...	...
" x M. 55 ...	P.E.S.	9	...	...	...
" x M. 131 ...	"	4	...	...	...
" x M. 2316 ...	"	3	...	...	...
" x M. 2716 ...	"	6	...	...	...
" x M. 2916 ...	"	3	...	...	...
Striped Tanna x D.K. 74 ...	"	1	...	...	...
White Tanna (Mon Désert) x D.K. 74 ...	Béga	3	1	1	...
" x M. 55 ...	Béga	1	...	...	...
" x M. 2716 ...	Béga	1	...	...	...
55/74 x D. 109 ...	P.E.S.	1	...	...	...
55/74 x D. 109 (white) ...	P.E.S.	1	...	...	...
55/74 x D.K. 74 ...	C.E.S.	4	686	127	131
		239	36,653	6,760	6,371

2.—INTER-SPECIFIC CROSSES

Combination	Location of Cross	No. of arrows sown	No. of seedlings obtained	No. of seedlings potted at	
				C.E.S.	P.E.S.
I.—FIRST NOBILISED GLAGAH					
M. 131 x Glagah Cletak	... Béga	1	2,100	250	200
M. 131 x Glagah Djatiroto	... P.E.S.	2	438	184	223
R.P. 6 x Glagah Djatiroto	... „	1	84	...	84
		4	2,522	434	507
II.—FOURTH NOBILISED GLAGAH					
B.A. 11569 x P.O.J. 2878	... C.E.S.	2	4	...	...
M. 131 x „ „	... „	1	...	...	...
M. 2316 x „ „	... „	1	...	...	...
M. 1718 x „ „	... „	1	...	...	...
R.P. 6 x „ „	... „	2	20	...	9
White Tanna x „ „	... „	3	0	...	...
White Tanna x „ „	... P.E.S.	8	0	...	...
P.O.J. 2878 x M. 2316	... C.E.S.	1	1	1	...
		19	25	1	9

TABLE IV.—(Continued)

Combination	Location of Cross	No. of arrows sown	No. of seedlings obtained	No. of seedlings potted at	
				C.E.S.	P.E.S.
III.—CHUNNEE CROSSES					
B.A. 11569 x Co. 213	Béga	1	22	13	...
Mapou Perlé x " "	P.E.S.	1	...	...	...
M. 33 x " "	"	1	...	...	...
M. 131 x " "	Béga	1	14	7	...
M. 1516 x " "	P.E.S.	1	...	...	...
M. 1516 x " "	C.E.S.	1	...	...	...
M. 2016 x " "	"	1	19	19	...
M. 2316 x " "	P.E.S.	1	...	...	...
M. 3319 x " "	"	1	...	...	...
M. 1324 x " "	"	2	...	...	...
P.O.J. 213 x " "	Béga	1	20	17	...
" 213 x " "	C.E.S.	1	...	...	...
" 213 x D. 109	P.E.S.	4	4	...	2
" 213 x D. 625	"	1	...	...	...
" 213 x D.K. 74	"	2	8	...	8
" 213 x D.K. 74	Béga	3	16	2	...
" 213 x M. 55	P.E.S.	2	...	...	...
" 213 x M. 55	C.E.S.	1	...	...	...
" 213 x M. 87	P.E.S.	2	53	...	53
" 213 x M. 131	Béga	1	...	...	...
" 213 x M. 131	P.E.S.	1	1	...	...
" 213 x M. 2316	"	1	4	...	4
" 213 x M. 2716	"	2	...	...	...
" 213 x M. 2716	Béga	3	17	1	...
" 213 x M. 2916	P.E.S.	4	3	...	3
" 213 x M. 117	"	1	...	...	...
" 213 x M. 3317	"	1	1	...	1
" 213 x M. 3517	"	2	30	...	30
" 213 x M. 3517	Béga	2	15	...	...
" 213 x M. 1221	P.E.S.	2	1	...	1
" 213 x M. 1274	"	2	...	...	...
" 213 x R.P. 6	"	2	...	...	...
" 213 x R.P. 8	"	1	...	...	...
" 213 x Senneville	"	3	1	...	1
" 213 x D. 109 (white)	"	1	...	...	...
R.P. 6 x Co. 213	"	2	...	...	...
R.P. 8 x Co. 213	"	2	...	...	...
White Tanna x Co. 213	"	7	...	...	...
55/74 x Co. 213	"	1	8	...	8
		69	237	59	111
IV.—S. SINENSE CROSSES					
D.K. 74 x Uba Marot*	P.E.S.	1	407	257	150
M. 2316 x Uba Marot	"	1	...	...	...
M. 3319 x Uba Marot	"	2	...	...	...
M. 2820 x Uba Seedling Brown Sport	"	2	...	...	...
Uba x M. 55	"	3	...	...	...
Uba x Uba Marot	"	1	...	...	...
Uba Seedling x D. 625	"	1	...	...	...
" x D.K. 74	"	2	...	...	...
" x M. 55	"	2	4	...	4
" x M. 3317	"	1	...	...	...
" x M. 1821	"	2	...	...	...
" x R.P. 8	"	1	...	...	...
U. Seedling Brown Sport x M. 2716	C.E.S.	2	...	...	...
White Tanna x Uba Marot	P.E.S.	10	...	...	...
White Tanna (Mon Désert) x Uba Marot	Trianon	3	...	...	...
55/74 x Uba Marot	P.E.S.	1	9	...	9
		35	420	257	163

* Origin doubtful, supposed to be Uba Seedling.

TABLE IV.—(Continued)

Combination	Location of Cross	No. of arrows sown	No. of seedlings obtained	No. of seedlings potted at	
				C.E.S.	P.E.S.
V.—OTHER COMBINATIONS					
P.O.J. 2878 x Uba Rayée ...	C.E.S.	1	7	...	7
" 2878 x Uba Marot ...	"	1	143	125	...
P.O.J. x 2 x D 625 ...	P.E.S.	1	...	...	...
P.O.J. x 2 x R.P. 6 ...	"	1	1	1	...
Uba Seedling x Co. 213 ...	"	2	8	...	6
" x Co. 213 ...	C.E.S.	3	498	188	150
" x P.O.J. 2878 ...	"	1	9	7	...
M. 1516 x P.O.J. x 2 ...	P.E.S.	1	...	...	...
M. 1022 x P.O.J. x 2 ...	"	1	...	...	...
White Tanna x P.O.J. x 2 ...	"	4	...	...	...
P.O.J. 213 x Uba Seedling ...	C.E.S.	3	...	...	...
P.O.J. 2364 x H. 456 ...	imported fuzz	...	3	3	...
		19	669	324	163
Total Inter-Specific Crosses ...	...	146	3,973	1,075	953

3. CROSSES MADE IN JAVA.

Combination	No. of arrows sown	No. of seedlings obtained	No. of seedlings potted at	
			C.E.S.	P.E.S.
P.O.J. 2722 x E.K. 28 ...	$\frac{1}{2}$	15	...	11
P.O.J. 2875 x E.K. 28 ...	$\frac{1}{2}$	76	..	32
S.W. 499 x Kassoer ...	$\frac{1}{2}$	15	..	15
P.O.J. 2364 x E.K. 28 ...	$\frac{1}{2}$	19	..	18
P.O.J. 2940 x Kassoer ...	$\frac{1}{2}$	80	..	32
P.O.J. 2722 x P.O.J. 2940 ...	$\frac{1}{2}$	1,450	110	164
	3	1,655	110	272

4. SELFINGS

Variety	Location	No. of arrows sown	No. of seedlings obtained	No. of seedlings potted at	
				C.E.S.	P.E.S.
Ba. 11569 ...	Béga ...	1	...	...	...
Co. 213 ...	Béga ...	2	33	15	...
D. 625 ...	P.E.S. ...	?	?	...	10
D.K. 74 ...	Béga ...	2	141	91	...
D.K. 74 ...	C.E.S. ...	1	...	...	...
M. 131 ...	C.E.S. ...	1	...	...	...
M. 131 ...	P.E.S. ...	2	65	...	64
M. 2316 ...	P.E.S. ...	2	1	...	1
M. 2316 ...	Béga ...	2	17	12	...
M. 2716 ...	Béga ...	1	18	6	...
M. 2916 ...	P.E.S. ...	2	500	250	141
M. 3517 ...	Béga ...	1	3	...	...
P.O.J. 2878 ...	C.E.S. ...	1	1	...	...
R.P. 6 (red anthers) ...	Béga ...	1	160	66	...
R.P. 6 ...	C.E.S. ...	1	...	...	...
R.P. 6 ...	P.E.S. ...	1	14	...	14
Uba Marot ...	P.E.S. ...	2	13	...	13
Uba Seedling ...	C.E.S. ...	1	...	...	...
		24	966	440	246

5. UNCONTROLLED POLLINATION

Variety	Location	No. of arrows sown	No. of seedlings obtained	No. of seedlings potted at	
				C.E.S.	P.E.S.
B. 2471 ...	C.E.S. ...	1	...	...	...
B. 3390 ...	P.E.S. ...	?	92	10	45
B. 3390 ...	C.E.S. ...	1	14	10	...
B. 6308 ...	C.E.S. ...	1	11	8	...
B. 6450 ...	C.E.S. ...	1	...	...	...
Ba. 11569 ...	C.E.S. ...	1	3	3	...
Ba. 11569 ...	Béga ...	2	63	46	...
Co. 213 ...	Béga ...	6	234	168	...
D.K. 74 ...	P.E.S. ...	?	300	...	230
D.K. 74 ...	Béga ...	4	236	143	...
D.K. 74 ...	C.E.S. ...	2	73	50	...
D.K. 74 ...	St. Aubin ...	2	34	17	...
D.K. 74/70	C.E.S. ...	2	...	...	...
D. 109 ...	P.E.S. ...	?	200	...	118
H. 109 ...	Highlands ...	5	...	...	...
Louzier ...	Highlands ...	2	7	7	...
M. 33 ...	P.E.S. ...	2	4	...	4
M. 55 ...	P.E.S. ...	7	500	...	454
M. 55 ...	C.E.S. ...	1	0	...	...
M. 55 ...	St. Aubin ...	?	228	167	...
M. 131 ...	C.E.S. ...	2	0	...	...
M. 131 ...	Béga ...	5	2,100	230	406
M. 131 ...	P.E.S. ...	1	2	...	2
M. 252 ...	C.E.S. ...	1	0	...	...
M. 2316 ...	C.E.S. ...	3	6	0	...
M. 2716 ...	Béga ...	5	151	143	...
M. 2716 ...	P.E.S. ...	1	?	...	187
M. 117 ...	Béga ...	2	4	1	...
M. 3319 ...	C.E.S. ...	1	0	...	...
M. 2720 ...	C.E.S. ...	2	13	13	...
M. 221 ...	C.E.S. ...	1	30	16	...
M. 1324 ...	C.E.S. ...	1	0	...	...
M. 2425 ...	C.E.S. ...	1	2	0	...
P.O.J. 213	C.E.S. ...	1	0	...	...
P.O.J. 213	Béga ...	1	4	2	...
P.O.J. 2878	C.E.S. ...	3	21	1	20
P.O.J. 2878	Java ...	$\frac{1}{2}$	35	...	22
P.O.J. x 2 ...	C.E.S. ...	1	15	11	...
R.P. 6 ...	Béga ...	8	5,080	952	247
R.P. 6 ...	C.E.S. ...	7	10	2	...
R.P. 6 ...	P.E.S. ...	9	55	...	39
R.P. 8 ...	St. Aubin ...	?	4	2	...
R.P. 8 ...	P.E.S. ...	10	31	...	29
R.P. 73 ...	C.E.S. ...	1	0	...	...
White Tanna (Mon Desert) ...	St. Aubin ...	2	1	0	...
White Tanna	Q. Victoria...	50*	2	2	...
White Tanna	B. Vallon ...	50*	0	...	...
55/74 ...	C.E.S. ...	?	?	4	73
White Tanna	P.E.S. ...	355	0	...	...
R.A. 29 ...	P.E.S. ...	5	18	...	...
		569 $\frac{1}{2}$	9,593	2,008	1,876

6.—RECAPITULATION TABLE

1. Crosses between "noble" canes	...	239	36,653	6,760	6,371
2. Inter-specific crosses	...	146	3,973	1,075	953
3. Crosses made in Java	...	3	1,655	110	172
4. Selfings	...	24	966	440	246
5. Uncontrolled Pollination	...	569 $\frac{1}{2}$	9,593	2,008	1,876
Grand Totals	..	981 $\frac{1}{2}$	52,840	10,393	9,715

NOTE:—The discrepancy between the grand totals in Tables III and IV (6) is due to the fact that Glagah G. C. from Java have been included in the former but not in the latter.

*Approximatively

REPORT OF BIO-CHEMIST

1. INTRODUCTION

During the period when the Senior Geneticist was away on duty in Java, I was in charge of all the work connected with the crossing programme. On the return of the Senior Geneticist, I superintended the work on the three sugar estates: Béga, Trianon and Highlands, until the end of the crossing season, when my chemical apparatus arrived. From the crosses made on these three estates, approximately 25,000 seedlings were raised. Mr. Halais was engaged in laboratory work, chiefly with regard to pollen germination tests. The following miscellaneous investigations were carried out during the year under review.

2. USE OF THE REFRACTOMETER IN CANE SEEDLING SELECTION WORK

An investigation was carried out with regard to the use of the above instrument as an aid in selecting cane seedlings. The instrument used was a Standard Carl Zeiss Refractometer which, though not so convenient for carrying about as the Hand Refractometer, may easily be used in the field. The investigation was divided into two parts:—

(a) Single canes from different varieties were analysed for sucrose by Polarisation, Brix and Solids in the juice calculated as sucrose from the Refractive Index of spot samples.

(b) Whole stools of seedlings were analysed in the same way.

As a result of this work, the following procedure was recommended for the examination of seedlings. Where the number of seedlings left after the preliminary selection based on habit, susceptibility to disease, freedom from insect pests, etc., is comparatively large, then only three spot samples per stool should be taken, but where the number is conveniently small, then for the sake of greater reliability of results, six spot samples should be taken. The method of sampling is as follows: three or six well developed canes in the stool are selected, and then a core is cut out of each cane by means of a cork borer about 1/5" in diameter. These cores should be taken in succession from one-quarter of the way down the cane, the middle and three-quarters of the way down the cane. Each core is then separately analysed, the sample being squeezed by a pair of cutting pliers and the drop of juice expressed being placed on the prism of the refractometer. From the mean of the 3 or 6 readings, the total solids in the juice, calculated as sucrose, may be determined from tables. The degree of reliability with which the results may be regarded is shown by the following coefficients of correlation. When six spot samples are taken, the coefficient of correlation between the sugar %grs. juice by polarisation and the solids in the juice calculated as sucrose from the refractive indices of the spot samples is $+0.899 \pm 0.012$. When only three spot samples are taken, the coefficient is $+0.826 \pm 0.015$. These coefficients are calculated from the results of the analyses of about 30 stools of seedling canes.

3. METHOD OF SAMPLING EXPERIMENTAL PLOTS OF SUGAR CANE

These experiments were conducted on various sized plots, i.e., 30, 90, 150, and 600 holes. At the start random selection was tried, but this was found to be impracticable where a large number of plots have to be sampled. Consequently, the stools to be sampled were chosen in a regular manner, but the individual cane to be taken for the sample was chosen as follows:—The sampler faced the stool and chose the cane nearest to him. Now counting in a clockwise direction, the seventh cane was taken for the sample. By this means it was hoped to eliminate the unconscious selection of superior canes, which undoubtedly occurs if the work is left to the cane cutters. This is well borne out by one experiment with 90 holes of D.K. 74. This plot was sampled by taking the seventh cane from each tenth stool, ten samples (1 to 10) being taken in this way. Two labourers were each instructed to take one sample of ten canes (11 and 12). The results of analyses were:—

				Weight of sample kgs.	Brix	Sucrose % grs. juice
Samples	1 to 10	...	...	7.9 ± 0.6	19.91 ± 0.27	17.86 ± 0.30
"	11 & 12	...	...	13.5	20.6	18.63

Practically all the plots to be sampled in Cane Variety Experiments consist of 30 holes. The samples from these plots were taken by cutting the seventh cane of every third stool before the plot was cut. The sample was weighed and the weight thus obtained was added to the weight of cane per plot when the harvesting was done.

For plots containing up to 150 holes, it would seem that one cane from each of ten stools evenly distributed over the whole area is sufficient to give a sample fairly representative of the whole. The following table shows the average for three samples and the range:—

				Brix	Sucrose % grs. juice	Glucose % ccs. juice
Mean	...	...	...	19.27	18.01	0.17
Range	...	...	...	19.20 - 19.40	18.0 - 18.04	0.12 - 0.19

4. ESTIMATION OF CANE YIELDS IN MANURIAL EXPERIMENTS BY CANE MEASUREMENTS

It would often be of value to have some other method of comparing yields in demonstration plots other than that of visual observation, which in many cases, even with competent observers, leads to quite erroneous results. The most obvious method with sugar cane is to obtain measurements of a number of stools representative of the whole plot, the measurements to be made being :—

- (1) The length of the cane from ground level to the highest leaf triangle (*l*).
- (2) The circumference (*c*).
- (3) The number of canes per stool (*n*).

From the average figures for any plot the factor nlc^2 may be calculated, a factor comparing the volume of cane on the different plots. These measurements have been made on two experimental fields. In one case, 14 plots each of 120 stools were measured just before harvesting with the following results :—

ORDER OF MERIT

By weighing ... 1, 5, 2, 3, 13, 10, 14, 12, 6, 4, 8, 7, 11, 9.
By measurement ... 1, 2, 5, 13, 10, 3, 14, 12, 4, 8, 6, 7, 11, 9.

In the other case the results were of a similar order when dealing with a single variety of cane, but it would seem that the density of different canes vary, so that the method would not be applicable to variety trials. Thus the volume of cane indicated by the formula nlc^2 was greater for Striped Tanna than for White Tanna, but from the actual weights, the latter was superior to the former.

5. PHOSPHORIC ACID IN CANE JUICE

During the crop seasons of 1929 and 1930, considerable numbers of determinations of phosphoric oxide in cane juice have been carried out, with the idea of trying to detect deficiencies in the soil of this plant food.

Two methods of analysis were originally employed :—

- (a) A modified Pemberton Newmann Method, by Springer and Davies ;
- (b) The colorimetric Method of Atkins.

A mean of 18 determinations by method (a) gave 0.052% P_2O_5 and by method (b) 0.051% P_2O_5 per 100 ccs of Juice. Duplicate analyses were made and it was found that the duplicates agreed better in method (b) than in (a). For ease and rapidity of manipulation the colorimetric method is much the superior of the other, and consequently was the only one used for subsequent determinations.

Various limits have been suggested as indicating a lack of available phosphoric acid in the soil, the limit proposed being 0.02—0.03 grs. of P_2O_5 per 100 ccs of juice. These limits however have been generally worked out for one variety of cane. During the season 1929, canes were analysed from Réduit, Britannia S. E., Rich Fund S. E., Beau Vallou S. E., Highlands S. E. and Réunion S. E. and during the season 1930 from Réduit, Pamplemousses, Circonstance, Bonne Mère, St. Aubin and Mon Rocher. These localities may be taken as representative of practically the whole island.

The average contents of the different varieties show great similarity for the two years as the following table shows :—

		1929		1930	
		No. of Tests	Average P_2O_5 content	No. of Tests	Average P_2O_5 content
White Tanna	...	66	0.037 grs. o/o ccs	38	0.033 grs. o/o ccs
M. 2316	...	6	0.023 " "	8	0.025 " "
D. K. 74	...	19	0.022 " "	34	0.020 " "
M. 2716	...	6	0.021 " "	8	0.020 " "
R. P. 8	...	38	0.015 " "	38	0.008 " "
R. P. 6	...	6	0.013 " "	36	0.020 " "
BH. 10 (12)	...	6	0.008 " "	6	0.013 " "

It is thus seen that no one limit may be set as indicating a sufficiency, as the requirements of different cane varieties vary greatly. Whether these large differences be due to the different requirements of the various cane varieties for the production of optimum growth, or whether they are due to varying absorptive capacities of the root systems of the several varieties is not known. Thus it is quite possible that although the soil contains sufficient available phosphoric acid for White Tanna, yet it does not contain sufficient for varieties such as R. P. 8, BH. 10 (12), etc.

A marked correlation was found between the phosphoric oxide content of juice and the pH of the soil in the case of one estate, the coefficient of correlation being 0.73 ± 0.09 , so that it is suggested that by liming the availability of the soil phosphates may ultimately be increased. This is further borne out by a liming experiment conducted at the Central Experiment Station. One field was divided into 24 plots, each plot consisting of 30 holes of each of the following varieties: White Tanna; Striped Tanna; R. P. 6; R. P. 8 and

D. K. 74. To eight of these plots, no lime was added. To another eight 10 tons of lime per acre were spread on the surface; and to the remainder 10 tons of lime per acre was dug in. The juice from all these plots was analysed, the averages being given below:—

No lime plots	...	...	0.013	grs	P ₂ O ₅	per 100 ccs. of juice
Lime on surface plots	...	...	0.014	"	"	"
Lime dug in plots	...	...	0.016	"	"	"

It is thus seen that there are indications of increased availability of the soil phosphoric oxide even in the first year after application of lime.

In the juice from canes received from the Central Experiment Station and Circonstance, the phosphoric oxide was considerably lower than in that from the other localities and on the strength of this it is suggested that Phosphate Manurial Trials may be the more profitably carried out in these places.

6. METHODS FOR ISOLATION OF CANE ARROWS

Cane Breeders are often handicapped by the difficulty of efficiently isolating the cane arrows which they are using as crossing material. Two methods have been used with success in other cane growing countries, namely:—

(a) That of rooting canes a certain distance above ground level and then severing; and

(b) That of cutting canes and keeping them in preservative solutions.

Both of these methods were tried during the past crossing season.

(a) ISOLATION BY ROOTING:—This method consists of placing a suitable container—either a tin or a wire netting cage lined with sacking—around the cane to be isolated and supported at a convenient height. The container is then filled with soil and regularly watered, so that the soil is always moist, to induce as far as possible a vigorous growth of roots from the root bands. When the roots have grown well, then the cane is cut just below the container. This method was not highly successful, as in only a small proportion of severed canes were normal arrows produced. Following severance, severe wilting often occurred and although the fully expanded leaves recovered, the central spindle seemed to be permanently affected, and a top-rot ensued, and the uppermost lateral buds started to sprout. Again, in many cases the canes died although they had produced a fair number of roots. In nearly 40% of the trials, the canes gave no roots at all.

The number of seedlings obtained from rooted female parents at the Central Experimental Station, Redit, was 102, whilst at the Pamplémousses Experimental Station, the number was 1090. This method of isolation was in one case extremely helpful at Redit; the only arrow of *Saccharum spontaneum* (Glagah cletak) produced during the season was rooted, and as it flowered early in the season, it was severed and taken to Béga, where it was crossed with M. 131 in a small glass lantern. The latter arrow produced 2,100 seedlings, whilst the Glagah arrow itself gave nearly 600 seedlings.

On account of the poor results obtained by the above methods, further methods for inducing root formation were tried later in the season, and of these the best results were obtained with a mixture of coir and cow dung, roots being produced in every case, whereas in the case of mixtures of sphagnum moss and soil and of coir and soil, practically no root emission occurred. As these trials took place late in the season the canes were not severed, but further work will be done on these lines in preparation for the next crossing season.

(b) ISOLATION IN NUTRIENT AND PRESERVATIVE SOLUTIONS:—At the start various nutrient solutions, such as Sack's and Knop's solutions, were employed for the growth of cut canes, but in no case was a good result obtained, in spite of the fact that one internode was cut off from the bottom of each cane every second day. It was noticed that the solution soon became turbid and the canes had a slimy covering, and consequently the failure was attributed to the growth of micro-organisms in the vascular system of the cane. The addition of disinfectants such as phenol or formaldehyde to these solutions in order to inhibit the growth of micro-organisms failed to bring about any marked improvement although Phenol certainly caused a slight improvement.

The Hawaiian workers' method of keeping cut canes in 0.03% SO₂ solution was then tried with success, seedlings being obtained from the fuzz of arrows kept in SO₂ solution from the time the arrow had just protruded until maturity of the seeds. In view of the fact that the sulphur dioxide is a disinfectant, other substances of the same nature, such as Chinosol and Potassium chlorate were tested, and although the former gave very much better results than did the latter, yet it was much inferior to Sulphur dioxide solution. Empirin was also tried without success. Further tests were made as to the optimum strength of SO₂ solution, the strengths tried being 0.02%, 0.03%, 0.04%, 0.06%, but between the different groups of canes there was practically nothing to choose.

The best results with sulphur dioxide solution were obtained by placing it in glazed earthenware or glass containers, when as above mentioned viable seed was obtained. In the field, however, for open crosses by the Java method, the sulphur dioxide solution was kept in Bamboo pots of about 3 litres capacity, but in these conditions the canes must be replaced at the end of about the fifth day, possibly on account of some toxic substance present in the bamboo. One internode should be cut off the end every second day under the surface of

the liquid and if, as sometimes occurred, the cane becomes slimy, it should be well washed before being replaced in the sulphur dioxide solution. When the canes are cut, the number of fully developed leaves should be reduced to about six per stalk.

It may well be that certain varieties of cane are better adapted for being preserved in sulphur dioxide solution than are others. Considerable differences were noted in the field with bamboo pots, but whether these differences would persist if they were kept in glazed earthenware vessels cannot be definitely stated. The variety M. 2716 when kept in SO_2 solution in these vessels showed no signs whatever of deterioration during the whole of its flowering period, large amounts of fertile pollen (about 33% germination on sugar-agar medium) being shed for several days.

These experiments, both with rooted canes and cut canes in nutrient solutions, are being continued.

7. PETROLOGY OF MAURITIUS ROCKS.

A limited number of rock samples have been examined during the year from different localities, and it was found that they fell into two groups.—dolerites and basalts.

The dolerites are characterised by large well shaped crystals of olivine, which are frequently altered along the edges and cracks to Bowlingite or iddingsite. They present an ophitic structure, the crystals of plagioclase (generally labradorite) being in many cases quite large. The augite is present in the form of small rounded granules, which show a purplish coloration, probably due to the presence of titanium.

The following mineralogical analyses are fairly typical.

Mineral		C.E.S.		Port Louis	
		Volume	Weight	Volume	Weight
Olivine	...	13.60	14.55	19.10	20.50
Augite	...	32.10	33.30	28.20	29.30
Felspar	...	47.90	43.20	47.60	43.10
Iron ore	...	6.40	9.00	5.10	7.10

In many cases a vesicular structure has been noticed, the vesicles often being lined with crystals of calcite.

The basalts show a very finely crystalline structure, with a small amount of glassy material present, with small crystals of olivine and biotite. The extinction angles of the larger plagioclase crystals correspond to andesine or labradorite.

8. SOILS

Studies in connection with soil fertility have been started as part of the investigation into phosphoric oxide in the juice of the sugar cane. Efforts have been made to determine the amount of water soluble phosphates in several soils, but up to the present only traces have been found. Experiments are in progress to determine the power which these soils possess of fixing phosphoric acid in the soil in an insoluble condition.

Certain single value soil properties, moisture content at the sticky point and the index of texture, are being tested to find their significance with local soils.

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Bio-Chemist.

the liquid and it is sometimes observed that the same becomes solid, it should be well washed before being returned to the liquid. When the same is returned to the liquid, it should be well washed before being returned to the liquid. When the same is returned to the liquid, it should be well washed before being returned to the liquid.

It may well be that certain varieties of clays are better adapted for certain purposes than others. It may well be that certain varieties of clays are better adapted for certain purposes than others. It may well be that certain varieties of clays are better adapted for certain purposes than others. It may well be that certain varieties of clays are better adapted for certain purposes than others.

These experiments, both with coated clays and with clays in different solutions, are being continued.

A PETROLOGY OF MAURITIUS ROCKS.

Of limited number of rock samples have been examined during the year from 1910 to 1911, and it was found that they fall into two groups—volcanic and igneous.

The volcanic rocks are characterized by being well shaped crystals of all sizes, which are frequently aligned along the edges and corners of the crystals. They present a typical structure, the crystals of plagioclase being usually tabular, and in many cases the larger plagioclase crystals correspond to a certain type of structure, which show a typical coloration, probably due to the presence of titanium.

The following mineralogical analyses are fairly typical.

Mineral	O.M.		For local	
	Volume	Weight	Volume	Weight
Orthite	13.00	11.00	14.10	10.30
Augite	32.10	28.30	38.20	28.80
Trisart	47.00	43.20	47.50	43.10
Iron ore	0.90	0.90	0.10	0.10

In many cases a vesicular structure has been noticed, the vesicles often being lined with crystals of calcite.

The igneous rocks are very finely crystalline structures, with a small amount of glassy material present, with small crystals of quartz and feldspar. The extinction angles of the larger plagioclase crystals correspond to a certain type of structure, which show a typical coloration, probably due to the presence of titanium.

8. Oils

Studies in connection with oil formation have been started as part of the investigation into the geology of the island. It is found that the amount of water-soluble hydrocarbons in certain rocks, but as to the present only traces have been found. Experiments are in progress to determine the power which these rocks possess of taking hydrocarbons into the soil in an insoluble condition.

Certain single well properties, including content at the alkali point and the index of refraction, are being tested to find their significance with local soils.

M. GRAVE,
Bio-Chemist

MAURITIUS,
1911